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LARS CONTRACT REPORT 080983

CR-173007

QUARTERLY PROGRESS REPORT

FOR

LANDSAT-4 IMAGE DATA QUALITY ANALYSIS

FOR PERIOD INCLUDING

MAY 10, 1983 - AUGUST 9, 1983

NASA CONTRACT NAS5-26859

TO: NATIONAL AERONAUTICS & SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT ROAD
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LARS Contract Report 080983

Introduction

This report covers work done on NASA Landsat-4 data quality evaluation under Contract NAS5-26859 for the period May 10 through August 9, 1983. The period consisted of classification analysis of seven-band TM data over a site in the Des Moines, Iowa area. Significant results of this analysis are presented on the following pages.

Problems

No data or procedural problems occurred during the quarter.

Publications

A paper was presented June 23, 1983 at the LARS ninth international symposium on Machine Processing of Remotely Sensed Data: "Estimation of a Remote Sensing System Point-Spread Function From Measured Imagery," by C.D. McGillem, P.E. Anuta, E. Malaret, and K.B. Yu.

Recommendations

No recommendations are made in this quarter.

Funds Expended

The funds expended on the project are reported periodically by the Purdue Office of Contract and Grant Business Affairs to the sponsor on NASA Form 533M. These are issued monthly. Specific disclosure of funds expended in this report is not allowable.

Multispectral Classification of TM Data
Des Moines, Iowa Test Site

TEST SITE DESCRIPTION AND DATA UTILIZED

To determine the information content of the TM data, a multispectral classification of an area that includes Polk County, Iowa, the city of Des Moines and Saylorville Reservoir was performed.

The TM data utilized in this study were collected on September 3, 1983 (Scene ID: 40049-16264) and the test site covers a square area of 1000 lines by 1000 columns, or approximately 800 Km^2.

Polk County lies between latitudes 41°25'N and 41°50'N and from longitude 93°20'W to 93°25'W. The general topography is flat to undulating, with some steep area around the streams and rivers. The geology of the area consists mainly of a Wisconsin Glacial Till with some loess deposits in the southern portion. The entire area is underlain by a shale bedrock of the Des Moines group.

The following reference (ground truth) data for the study area were obtained for training field selection:

a) U.S.G.S. topographic map at a scale of 1:250,000 prepared in 1954, revised 1972 (Des Moines Quadrangle)

b) nine U.S.G.S. topographic maps, 7.5 minute series, at a scale of 1:24,000, some prepared in 1956, revised 1976, others prepared in 1972: Granger, Polk County, Elkhart, Grimes, Commerce and Des Moines NE, NW, SE, and SW

c) four 9x9 color infrared transparencies obtained on May 2, 1978, at a scale of approximately 1:74,500

d) low-altitude 35-mm color aerial photography for selected agricultural areas obtained within one week of the Landsat overpass

e) plot maps at a scale of approximately 1:63,360 for selected agricultural areas

f) photo-based section maps with field identification numbers for selected agricultural areas at a scale of approximately 1:15,840

g) color and color-IR oblique aerial photographs obtained from approximately 5,000 feet on May 2, 1983.

ANALYSIS PROCEDURE

The multispectral classification was performed following the analysis sequence described by the flow chart shown in Figure 1.

Essentially, seven heterogeneous areas within the entire test site were selected to define candidate spectral training classes using a clustering algorithm. In addition to the 91 cluster (non-supervised) classes, three supervised training classes were defined and subsequently were included in the training statistics file.

The identity of all 94 candidate training classes was determined using the available reference data, and through an in-depth analysis of the inter-class separabilities the original 94 candidate training classes were reduced to 42 spectrally separable final classes. Table I shows the list of these 42 spectral training classes.

Table II shows the minimum and average transformed divergence values for the 42 spectral classes and for the best subsets of TM spectral bands. It should be noted that the best spectral band for any combination of 1 through 7 bands is the first middle IR band (1.55 - 1.75 μm). The next best band is the near IR (0.76 - 0.90 μm), followed by the red band and then the thermal IR. The best combination of four bands includes one from each of the four regions of the spectrum (visible, near IR, middle IR and thermal IR).

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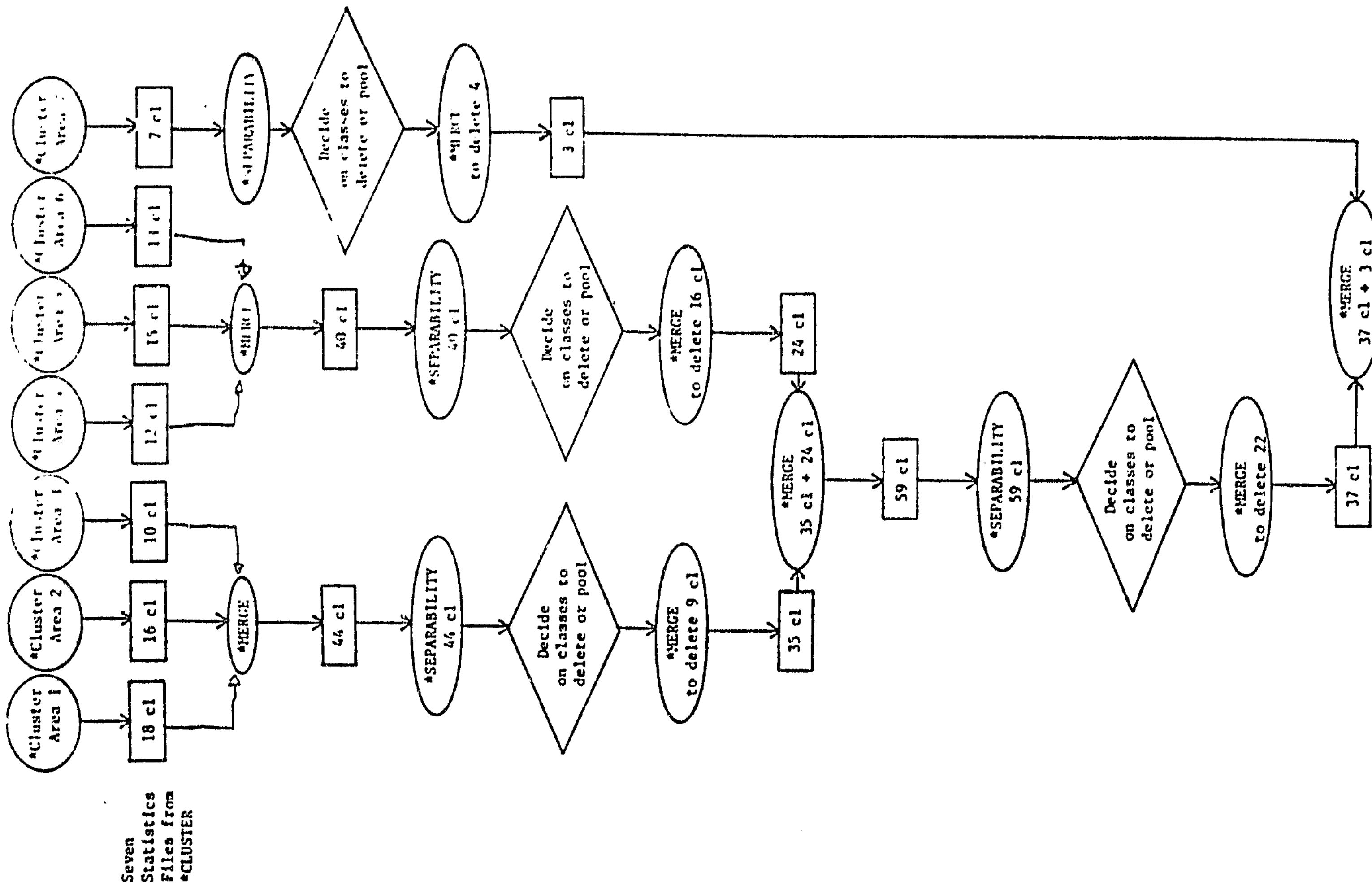

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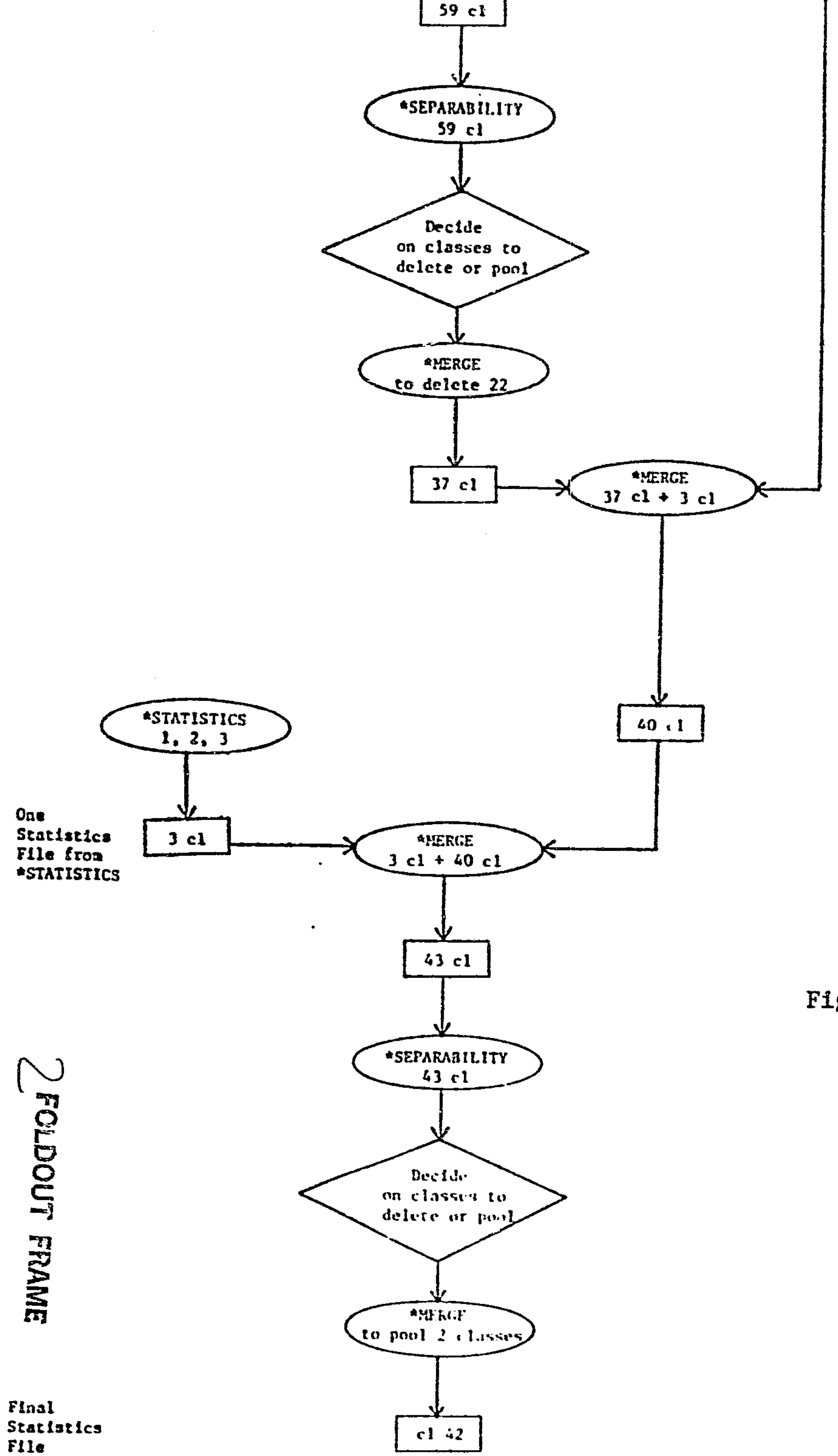
59 cl
*SEPARABILITY 59 cl
Decide on classes to delete or pool
*MERGE to delete 22
37 cl
*MERGE 37 cl + 3 cl
40 cl
*STATISTICS 1, 2, 3
3 cl
One Statistics File from *STATISTICS
*MERGE 3 cl + 40 cl
43 cl
*SEPARABILITY 43 cl
Decide on classes to delete or pool
*MERGE to pool 2 classes
cl 42
Final Statistics File

Figure 1.

Table I

CLASS NUMBER	CLASS NAME	CLASS NUMBER	CLASS NAME
1	FOREST1	22	SUBSTATION
2	FOREST2	23	QUARRY
3	CORN1	24	CONCRETE
4	CORN2	25	SLUDGE
5	SOY1	26	INDUSTRIAL1
6	SOY2	27	INDUSTRIAL2
7	SOY3	28	URBAN/HIWAY
8	SOY4	29	SOIL/HIWAY
9	SOY5	30	RESIDENTIAL1
10	SOY6	31	RESIDENTIAL2
11	WHEAT RESIDUE	32	BEACH1
12	GRASS1	33	BEACH2
13	GRASS2	34	BEACH3
14	GRASS3	35	SOILWET1
15	SOIL/VEG1	36	SOILWET2
16	SOIL/VEG2	37	MARSH
17	SOIL/VEG3	38	WATER1
18	FARM/GRASS	39	WATER2
19	ROAD/FARM	40	WATER3
20	BARESOIL1	41	WATER4
21	BARESOIL2	42	WATER5

Table II

SEPARABILITY
(Transformed Divergences)

CHANNEL COMBINATIONS	DIVERGENCE MIN	AVE.	BEST CHANNELS
1	1	1574	4
2	210	1880	4 5
3	522	1949	3 4 5
4	1090	1973	3 4 5 7
5	1356	1979	3 4 5 6 7
6	1405	1983	2 3 4 5 6 7
7	1553	1986	1 2 3 4 5 6 7

RESULTS

A preliminary comparison of the classification results with the available reference data shows that a great deal more useful information is contained in the TM data as compared with similar classifications of MSS data. A classification of the same test site using concurrent MSS data is being carried out and a quantitative comparison of the classification performance of both data sets will be included in the next report. Also, the results of classifying the TM data for the same test site, but using different classification schemes, such as 1)best four TM bands, 2) ECHO, 3) Hierarchical, and 4) principal components classifications will be reported at a later date.